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AT THE UNIVERSITY OF IOWA Annual Report,
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Department of Physics and Astronomy
THE UNIVERSITY OF IOWA

Iowa City, Iowa 52242



RESEARCH IN SPACE PHYSICS
AT THE UNIVERSITY OF IOWA

ANNUAL REPORT FOR 1978

Prepared by

J. A. Van Allen

J. A. Van Allen, Carver Professor of Physics and
Head, Department of Physics and Astronomy

July 1979

1.0 General Nature of the Work

1.01 Our broad objective is the extension of knowledge of the energetic particles and the electric, magnetic, and electromagnetic fields associated with the earth, the sun, the moon, the planets, comets, and the interplanetary medium.

1.02 Primary emphasis is (a) on observational work using a wide diversity of instruments of our own design and construction on satellites of the earth and the moon and on planetary and interplanetary spacecraft and (b) on phenomenological analysis and interpretation.

1.03 Secondary emphasis is (a) on closely related observational work by ground based radio-astronomical and optical techniques and (b) on theoretical problems in plasma physics as relevant to solar, planetary, and interplanetary phenomena.

1.04 Specific fields of current investigation are the following:

(a) All aspects of the energetic particles that are trapped in the earth's magnetic field and are transiently present in the outer magnetosphere including the magnetospheric tail of the earth; and of the solar, interplanetary, and terrestrial phenomena that are associated with these radiations -- solar flares, interplanetary magnetic fields and plasmas, aurorae, geomagnetic storms, corpuscular heating of the atmosphere, electromagnetic waves and magnetostatic and electrostatic fields (both constant and variable)

in the magnetosphere, plasma flows in the magnetosphere, and the ionospheric effects of particle precipitation. This field of research was originated to a major extent by this laboratory.

(b) Corresponding studies of the magnetospheres of Jupiter, Saturn, and possibly Uranus.

(c) Origin and propagation of very low frequency radio waves in the earth's magnetosphere and ionosphere.

(d) Energetic electrons, protons, alpha particles, and heavier nuclei emitted by the sun; the interplanetary propagation and acceleration of these particles, including the effects of shock waves and the generation of electrostatic and electromagnetic waves in the interplanetary medium; and the access of such particles to the earth's magnetosphere.

(e) Solar modulation and the heliocentric radial dependence of the intensity of galactic cosmic rays.

(f) Radio-frequency emissions from both the quiescent and flaring sun and the implications thereof on the nature of the chromosphere and corona and on the acceleration and emission of energetic particles in solar flares.

(g) Shock waves in the interplanetary medium.

(h) The theory of wave phenomena in turbulent plasmas including the interplanetary medium and of the origin of super-thermal particles.

(i) Radio emissions from Jupiter and Saturn and the relationships of same to their magnetospheres.

(j) Radio astronomical study of pulsars, flare stars, and other stellar sources as an extension of our work on planetary magnetospheres and the sun.

The attached bibliography lists specific investigations completed and published in 1978.

2.0 Currently Active Projects

2.01 Hawkeye 1 (Explorer 52, 1974-040A)

This satellite and its principal scientific instruments were designed and built at the University of Iowa and launched into a highly eccentric, nearly polar orbit from the Western Test Range on 3 June 1974. Hawkeye 1 re-entered the earth's atmosphere, as predicted, on 28 April 1978 after 667 orbits and nearly forty-seven months of successful in-flight operation. Active analysis on the large body of data continues.

[Van Allen, Frank, Gurnett, Chen, Craven, Kurth, Green, Randall et al.]

(Support by Office of Naval Research and NASA Headquarters)

2.02 Pioneers 10 and 11

The two spacecraft, both carrying University of Iowa energetic particle detectors, were the first and, through 1978, the only ones to make encounters with Jupiter. [In March and July 1979, respectively, Voyagers 1 and 2 successfully encountered Jupiter.]

The large body of data that they yielded has produced dramatic advances in knowledge of Jupiter and has stimulated a fresh wave of theoretical as well as ground-based astronomical work on this planet and its satellites. They have also yielded a unique body of data on the cosmic radiation and the physical properties of the interplanetary medium to unprecedented distances from the sun. Both spacecraft and most of the scientific instruments (including ours) continue to operate properly. Data are received on a daily basis (~ 8 hours of data per day). Pioneer 10 is on a hyperbolic escape orbit from the solar system with heliocentric distances as follows: 23 January 1977, 12 AU; 30 September 1977, 14 AU; 7 June 1978, 16 AU; 13 February 1979, 18AU; 24 October 1979, 20 AU; March 1983, 30 AU; and September 1986, 40 AU. It is technically feasible to continue to receive data of good quality (at bit rates \geq 16 bits/sec) through 1985.

Pioneer 11 is targeted for encounter with Saturn on 1 September 1979. Samples of its heliocentric radial distances are as follows: 5 November 1977, 6 AU; 17 May 1978, 7 AU; 29 November 1978, 8 AU; and 18 June 1979, 9 AU. Following encounter with Saturn, it will also escape from the solar system.

The prospective survey of Saturn's magnetosphere for the first time is the element of highest future interest in the Pioneer 10/11 program. Meanwhile, the cosmic ray intensity measurements by both spacecraft are contributing to the solution of the

long standing, classical problem of the propagation of galactic cosmic rays in the solar system. Also, our instrument on Pioneer 11 is providing unique data on the acceleration of protons by shock waves in the interplanetary medium and on the propagation of solar electrons and protons at great distances from the sun.

Further work on the interpretation of the Jupiter encounter data from both spacecraft continues on an active basis.

[Van Allen, Goertz, Thomsen, Pesses, Randall, Sentman, Raiden, and Grosskreutz]

(Support by Ames Research Center/NASA and Office of Naval Research)

2.03 Explorer 47 (IMP-H)(1972-73A)(IMP-7)

This GSFC/NASA satellite of the earth was launched on 23 September 1972 into an approximately circular orbit of initial inclination 17° and semi-major axis $35.3 R_E$ (earth radii). The orbital inclination of this long-lived satellite had increased to 43.9 by December 1978 with a semi-major axis of $35.02 R_E$ and a period of 12.16 days. Operation is being continued by command only on an intermittent basis following an extended period of nearly continuous data acquisition. It carries a University of Iowa electrostatic analyzer for measuring the energy spectra and angular distributions of low energy electrons, protons, and heavier ions in the energy range 5 eV to 50 keV. The purpose of the experiment is to further the understanding of geomagnetic storms and aurora by investigating phenomena in the magnetotail of the earth. Data

from this experiment have contributed importantly to understanding plasma dynamics and particle flow in the magnetotail.

[Frank, Ackerson, and Yeager]

(Support by GSFC/NASA and NASA Headquarters)

2.04 Explorer 50 (IMP-J)(1973-78A)(IMP-8)

This 317 kg GSFC/NASA satellite was launched on 26 October 1973 into an orbit with inclination 28.2° , radial distances to perigee and apogee 23.8 and $46.4 R_E$, respectively, and period 12.2 days. By December 1978, these orbital parameters had changed to 44.4° , 30.29 and $40.38 R_E$, and 12.32 days. This satellite carries VLF radio receivers and electrostatic particle analyzers from the University of Iowa. A large body of high quality data in the earth's outer magnetosphere and magnetotail from both sets of experiments has been acquired, with operations continuing through 1978 on a reduced basis.

[Frank et al. on electrostatic analyzers]

[Gurnett et al. on VLF radio receivers]

(Support by GSFC/NASA)

2.05 Explorers 33 and 35, Explorer 43 (IMP-I)
(IMP-5), Explorer 45 (S³-A), and Ariel 4
(UK-4)

The operational lifetimes of these five spacecraft have terminated but study of the data from them continues on special problems. These satellites were operative during periods of high

solar activity. Collaborative work with investigators from other laboratories has been and continues to be a valuable feature of the data base.

[Van Allen, Frank, Gurnett, Craven et al.]

(Support by ONR and NASA Headquarters)

2.06 German American Solar Probes
 (HELIOS-I and II)

The interplanetary spacecraft HELIOS-I was launched successfully from Cape Canaveral on 10 December 1974 by a Titan Centaur vehicle. The heliocentric orbit is near the ecliptic plane with perihelion at 0.3 AU from the sun. The first perihelion passage was on 13 March 1975; subsequent perihelion passages occur at about six month intervals. Helios II was launched successfully on 15 January 1976 into a similar heliocentric orbit. The principal scientific purposes of the two missions are study of particle and field phenomena in the interplanetary medium at distances closer to the sun than have been reached previously. (The perihelion of Mariner 10's orbit was approximately at the orbit of Mercury at 0.39 AU.) One of the three American instruments on each of the two spacecraft is the University of Iowa plasma-wave radio receiver (10 Hz to 15 kHz). Good measurements from both Helios I and II are being obtained. One of the more interesting bodies of results has come from the use of a combination of Hawkeye 1 and Helios observations for direction-finding and tracing solar electron streams in the

interplanetary medium by way of the Type III radio emissions that they excite in the medium. It has also been established that such emissions occur at twice the local electron plasma frequency. Both spacecraft are now in their extended mission phases, with substantially reduced data acquisition.

[Gurnett, Anderson, Kurth et al.]

(Support by GSFC/NASA)

2.07 Voyagers 1 and 2
 (Formerly called Mariner Jupiter/Saturn
 1977 Missions)

The University of Iowa designed and built plasma-wave instruments for both of these planetary fly-by missions and is a member of the investigative team. Voyager 1 was launched successfully on 5 September 1977. It is scheduled to fly-by Jupiter in March 1979 and Saturn in November 1980. Voyager 2 was launched earlier and on a slower trajectory on 20 August 1977. It will fly-by Jupiter in July 1979 and Saturn in August 1981. A possible further option is a fly-by of Uranus in early 1986. Both instruments are operating well, with an exceptionally low level of spacecraft interference. The principal purpose of these investigations is to determine the properties of the plasmas in the magnetospheres of Jupiter and Saturn (and Uranus) by measuring very low frequency electrostatic and electromagnetic waves in situ. Information on the origin of dekametric emissions may be obtained inferentially. Both Voyagers have already yielded valuable new observations on

interplanetary Type III solar bursts and on plasma waves in the interplanetary medium. [The Jupiter fly-bys of Voyagers 1 and 2 on 5 March 1979 and 9 July 1979, respectively, were executed successfully, yielding a large body of data on plasma density and plasma wave phenomena (including lightning-induced whistlers) in the Jovian magnetosphere.]

[Gurnett, Shaw, Kurth et al.]

(Developmental support by ONR and NASA Headquarters)

(Hardware and data analysis support by Jet Propulsion Laboratory/NASA)

2.08 International Sun-Earth Explorers (ISEE)

Two University of Iowa experiments are on each of the two spacecraft of the ISEE-1, ISEE-2 ("mother-daughter") magnetospheric mission (formerly called International Magnetospheric Explorers).

Both spacecraft were launched by a single vehicle on 22 October 1977 and were then separated so as to fly independently in the same orbit but separated by a varying distance of the order of 1000 km along the orbit. Special features of this double mission are:

- (a) Sophisticated magnetospheric instrumentation.
- (b) High data rates (S-band) and correspondingly high time- and angular-resolution.
- (c) The capability of separating temporal from spatial effects, especially in the vicinity of the earth's magnetopause and bow shock and in the magnetotail.

- (d) Monitoring of the solar wind, solar energetic particles, and magnetospheric phenomena during a period of increasing and probably maximal solar activity (in ≈ 1980).

The initial orbit of ISEE-1 (NASA) and ISEE-2 (European Space Agency) was as follows:

Perigee altitude	279 km
Apogee altitude	138,108 km ($22.65 R_E$ radial)
Latitude of apogee	21.6°
Local time of first apogee	10.9^h
Inclination	28.7°
Period	57.43 hours

Early results from both University of Iowa instruments were of high quality, though the electrostatic analyzer on ISEE-2 failed in mid-January 1978. The other three instruments continue in proper operation, yielding the most advanced data thus far obtained on plasma physical phenomena in the earth's magnetopause, bow shock, and magnetotail. Analysis of ISEE-1, -2 data is one of the most active areas of work in our laboratory at the present time.

[Frank, Craven et al., low energy particle differential analyzers]

[Gurnett et al., plasma wave receivers]

(Developmental support by ONR and NASA Headquarters)

(Hardware and data analysis support by GSFC/NASA)

A third spacecraft of the ISEE program (ISEE-C) was launched on 12 August 1978. It is called a "heliocentric" mission because it was placed in a halo orbit near the (L1) Lagrangian point

of the earth-sun system, on the line joining the earth to the sun at a distance about $235 R_E$ sunward of the earth. Thus, it serves as an "up-wind" monitor of solar wind and other interplanetary conditions free of terrestrial-lunar interference.

Gurnett is a co-investigator on the plasma-wave experiment.

2.09 Theory

Theoretical studies are continuing on the propagation and acceleration of solar protons, alpha particles, and electrons in the interplanetary medium; on the emission of X rays and radio noise by the sun; on the generation and propagation of very low frequency radio waves in the magnetosphere and on the relationship of such waves to particle acceleration, diffusion, and precipitation; on shock waves in the interplanetary medium; and on the physical dynamics of the magnetospheres of Jupiter and Saturn.

[Goertz, Shawhan, Thomsen, Sentman, Pesses]

(Support by ONR, NSF, and NASA Headquarters)

2.10 Very-Long-Baseline and Radio-Interferometry

The ONR 60-ft parabolic antenna at the North Liberty Radio Observatory has been converted to a VLBI receiving station operating at a wavelength of 18 cm (OH line). It has been adopted as an element of the national VLBI network at this frequency. A substantial program of observations is underway, in collaboration with other VLBI observatories in the United States, Puerto Rico, and Germany.

[Mutel, Benson, and Phillips]

(Support by ONR, Research Corporation, and NASA)

2.11 Large Area Radio Interferometer

During 1972-'74 the University of Iowa collaborated with NOAA/Boulder and GSFC in constructing the largest area radio interferometer in the northern hemisphere. Both effective area and angular resolution exceed those of the Arecibo facility. The array is located at Clark Lake, California. The operating frequency is 34 MHz. The program of observations is continuing. Objectives of this work are to study the propagation of solar wind streams through interplanetary space (via interplanetary scintillation of compact radio sources); to observe dekametric radio emission from Jupiter; and to search for radio emissions from Saturn.

[Shawhan, Cronyn, Rickard, Hodges et al.]

(Support by NASA, NSF, GSFC/NASA, NOAA, and U. S. Air Force)

2.12 Dynamics Explorer
(Formerly called Electrodynamics Explorer)

This NASA program envisions a coordinated pair of orbiting spacecraft, one in an eccentric polar orbit with apogee at about $5 R_E$ and another in a circular low-altitude polar orbit. One or both may have orbital adjustment capability. The central theme of the DE program is study of the physical coupling of the magnetosphere, ionosphere, and neutral atmosphere of the earth.

Based on proposals submitted originally in November 1974, two University of Iowa experiments for DE were selected and funded. One of these is a set of global auroral imaging instruments and the other a set of plasma-wave ELF-VLF receivers. Both will be on the eccentric orbiter. At the present time, the construction of flight instruments is well advanced. The tentative launch date is early 1981.

[Frank, Craven, and Ackerson, auroral imaging photometers]

[Shawhan and Gurnett, plasma wave instrument]

(Proposal and engineering design support by ONR
and NASA Headquarters)

(Hardware support by GSFC/NASA)

2.13 Auroral Imaging

During the past five years a major effort has been devoted to developing a new type of sensitive spot-scanning "camera" for global-scale imaging of auroral emissions and other low-light-level emissions in selected wavelength bands from the earth's atmosphere. This work has included the outfitting of an optics research laboratory; the purchase and development of suitable sources; the construction and testing of prototype systems; and the development of computerized handling of imaging data. This work provides the basis for the global auroral imaging experiment for the Dynamics Explorer. The instrumentation is also applicable to other spinning spacecraft such as a Pioneer class spacecraft during planetary flybys or in planetary orbits.

[Frank, Ackerson, and Craven]

(Developmental work supported by Office of Naval Research)

2.14 Galileo
(Formerly called Jupiter Orbiter with Probe Mission)

This JPL/NASA mission was approved and given start-up funding in late October 1977. The scheduled launch date (shuttle with inertial upper stages) is January 1982 with arrival at Jupiter, after a close fly-by of Mars, in July 1985. During the approach phase an entry probe will be released. The mother spacecraft will be injected into a nearly-equatorial orbit around Jupiter with first apoapse at about $270 R_J$. Subsequent orbits will be chosen by powered maneuvers and close fly-bys of the Galilean satellites to optimize the fulfillment of scientific objectives of magneto-spheric, satellite, and planetary observations. The nominal mission will terminate in March 1987.

Two of the three University of Iowa proposals for instruments on Galileo were selected and underwent, after a period of design definition work, formal confirmation in late summer 1978. The two investigations and the primary investigators are as follows:

2.14.1 "A Plasma Wave Investigation for the 1981/1982 Jupiter Orbiter"

D. A. Gurnett, Principal Investigator
(U. of Iowa)
F. L. Scarf, Co-Investigator (TRW)
R. Gendrin, Co-Investigator (CNET)
C. F. Kennel, Co-Investigator (UCLA)
S. D. Shawhan, Co-Investigator
(U. of Iowa)

2.14.2 "Comprehensive Investigations of Jovian Plasmas with the Jupiter Orbiter Spacecraft (Jupiter Orbiter Probe 1981/1982 Mission)"

L. A. Frank, Principal Investigator
(U. of Iowa)

F. V. Coroniti, Co-Investigator (UCLA)
V. M. Vasyliunas, Co-Investigator (MPI)

The present status is one of final design and the construction of prototypes.

In addition, Van Allen has been appointed an Interdisciplinary Scientist as well as a member of the Project Science Group and chairman of the Magnetosphere Working Group.

(Proposal work supported by ONR and NASA Headquarters)

(Hardware support by JPL/NASA)

2.15 Spacelab and Orbital Flight Test Missions

Two University of Iowa investigations have been selected and confirmed for the early scientific program with the NASA shuttle/spacelab:

2.15.1 "An Ejectable Plasma Diagnostics Package (PDP) for the Spacelab 2 Mission"

(All Investigators from U. of Iowa)

S. D. Shawhan, Principal Investigator
L. A. Frank, Co-Investigator
D. A. Gurnett, Co-Investigator
N. D'Angelo, Co-Investigator

2.15.2 "An Ejectable Plasma Diagnostics Package (PDP) for the Space Shuttle Orbital Flight Test (OFT) Missions"

(Investigators, same as for 2.15.1)

The University of Iowa is constructing a complete subsatellite including all scientific instrumentation for preliminary flight on the OFT 4 mission, recovery and re-flight on Spacelab 2. On the latter flight it is planned to release the PDP into a close companion orbit with the mother craft. The objectives of these investigations are to determine the electromagnetic and plasma environments of the Spacelab as a basis for designing future experiments. In both cases the acquisition of in-flight data will extend over a time period of only about ten days. The subsatellite will be powered by storage batteries. The scientific instrumentation will be similar to that on Hawkeye 1.

(Proposal and preliminary design support by ONR and NASA Headquarters)

(Hardware support by Marshall Space Flight Center/NASA)

2.16 Firewheel Project

The Firewheel Project is a joint European-American experiment for the release of barium clouds in the earth's magnetotail at $\approx 15 R_E$ and for the study of the physical effects thereof, including the possible triggering of a geomagnetic substorm. The central planning agency is the Max Planck Institute at Garching, W. Germany. The European launch vehicle Ariane will be used. The University of Iowa has provided a plasma wave instrument for observation of the local plasma and magnetic effects produced by the

injected barium clouds. The instrument was a refurbished spare unit from the Hawkeye 1 program.

[Gurnett, Anderson et al.]

(Support by ONR)

2.17 International Solar Polar Mission
 (Formerly called Out-of-Ecliptic Mission)

This NASA/ESA mission contemplates a single launch of two instrumented spacecraft which will then be separated for independent flight. Both will be targeted to fly-by Jupiter in such a way that their subsequent orbits will be in a plane approximately perpendicular to the equatorial plane of the sun. They will be counter-revolving in this plane with one passing over the north pole of the sun as the other passes over the south pole (both at ~ 1 AU) and vice versa as their orbital motions continue. The unique objectives of these missions are to measure the properties of the interplanetary medium at high solar latitudes, to measure the intensity of galactic cosmic rays and the propagation of solar energetic particles, also at high solar latitudes, and to observe the polar caps of the sun.

The mission has been authorized and is now in the design definition phase. Launch is tentatively planned for February 1983. Gurnett at Iowa has been confirmed as a co-investigator on the Radio Astronomy Experiment (RAE) team and will build the Plasma Wave Assembly as one component of the TAE instrument.

3.0 Senior Academic Staff in Space Physics
 [31 December 1978]

<u>Van Allen, James A.</u>	Carver Professor of Physics and Head of Department of Physics and Astronomy
<u>D'Angelo, Nicola</u>	Professor of Physics
<u>Frank, Louis A.</u>	Professor of Physics
<u>Gurnett, Donald A.</u>	Professor of Physics
<u>Shawhan, Stanley D.</u>	Professor of Physics
<u>Goertz, C. K.</u>	Associate Professor of Physics
<u>Ackerson, Kent L.</u>	Associate Research Scientist [Research Associate]
<u>Craven, John D.</u>	Associate Research Scientist [Research Associate]
<u>Cronyn, Willard M.</u>	Associate Research Scientist [Research Associate]
<u>Randall, Bruce A.</u>	Associate Research Scientist [Research Associate]
<u>Shaw, Robert R.</u>	Associate Research Scientist [Research Associate]
<u>Anderson, Roger R.</u>	Assistant Research Scientist [Research Associate]
<u>Barbosa, David D.</u>	Assistant Research Scientist [Research Associate] [Effective 1 July 1978]
<u>Rickard, James J.</u>	Assistant Research Scientist [Research Associate]
<u>Thomsen, Michelle F.</u>	Assistant Research Scientist [Research Associate]
<u>Mehta, Naresh C.</u>	Research Investigator [Research Associate] [Effective 1 July 1978]

Also in Closely Related Work
(Astronomy and Plasma Physics)

<u>Knorr, Georg</u>	Professor of Physics
<u>Hershkowitz, Noah</u>	Professor of Physics
<u>Joyce, Glenn R.</u>	Professor of Physics
<u>Neff, John S.</u>	Associate Professor of Astronomy [On Leave Academic Year 1978-79]
<u>Fix, John D.</u>	Associate Professor of Astronomy
<u>Mutel, Robert L.</u>	Assistant Professor of Astronomy
<u>Nicholson, Dwight R.</u>	Assistant Professor of Physics

4.0 Senior Engineering and Administrative Staff
 [31 December 1978]

<u>Enemark, Donald C.</u>	Adjunct Associate Professor of Physics
<u>Brechwald, Robert L.</u>	Manager, Systems and Programming Services
<u>Rogers, John E.</u>	Senior Engineer
<u>Robertson, Thomas D.</u>	Contracts Administrator
<u>Lee, James A.</u>	Senior Research Assistant
<u>Owens, Harry</u>	Senior Research Assistant
<u>Burek, Barbara G.</u>	Research Assistant III
<u>Odem, Daniel L.</u>	Engineer IV
<u>Anderson, Roger D.</u>	Engineer IV
<u>English, Michael</u>	Engineer III
<u>Gabel, Ronald H.</u>	Engineer III
<u>Kruse, Elwood A.</u>	Engineer III [R and Q]
<u>Remington, Steve L.</u>	Engineer III
<u>Phillips, James R.</u>	Engineer III
<u>Freund, Edmund A.</u>	Supervisor, Technical Services [Departmental Machine Shop]
<u>Williams, R. Everett</u>	Supervisor, Technical Services [Departmental Graphics Services]
<u>Robison, Evelyn D.</u>	Project Assistant [Supervisor, Publications]
<u>Huneke, Alan C.</u>	Engineer II

All of those listed below are graduate students, engaged in research in space physics and astronomy.

<u>Appointnent</u>	<u>Principal Research Project</u>
Alport, Michael	Research Assistant
Baumback, Mark M.	Research Assistant ISEE/VLBI
Benson, John M.	Research Assistant Radio Astronomy
Claussen, Mark J.	Research Assistant Radio Astronomy
Cook, Bruce	Teaching Assistant Radio Astronomy
Gallagher, Dennis	Research Assistant VLF Radio (IMP-J)
Green, James L.	Research Assistant VLF Radio (Hawkeye)(IMP-J)
Grosskreutz, Cynthia	Teaching Assistant Pioneer 10/11
Hodges, Mark W.	Teaching Assistant Radio Astronomy
Kurth, William S.	Research Assistant VLF Radio (Hawkeye)(Voyager)
Pesses, Mark E.	Research Assistant Pioneer 10/11
Phillips, Robert B.	Teaching Assistant Radio Astronomy
Rairden, Richard L.	Research Assistant Pioneer 10/11

6.0 Advanced Degrees Awarded in Space
Physics at U. of Iowa
1 January 1978 -- 31 December 1978

M.S. Degree

Dennis Lee Gallagher (December 1978) "Auroral Kilometric Radiation:
Time-Averaged Source Location" [Gurnett]

Ph.D. Degrees

Tsan-Fu Chen (May 1978): "The Earth's Magnetic Field at Large Radial
Distances as Observed by Hawkeye 1" [Van Allen]

Joel M. Weisberg (December 1978): "The Absorption of Pulsar Signals
by Intervening Neutral Hydrogen" [Van Allen]

7.0 Publications and Research Reports
 in Space Physics
 1 January 1978 -- 31 December 1978

PUBLICATIONS

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- D. A. GURNETT and L. A. FRANK
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J. Geophys. Res., 83, 58-74, 1978
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On the Polarization and Origin of Auroral Kilometric Radiation
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Energization of Polar Cusp Electrons at the Noon Meridian
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- E. F. PETELSKI, U. FAHLESON, and S. D. SHAWHAN
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On the Modulation of the Jovian Decametric Radiation by Io
1. Acceleration of Charged Particles
J. Geophys. Res., 83, 2617-2627, 1978
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Energization of Charged Particles in Jupiter's Outer
Magnetosphere
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